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Water Quality Evaluation of Maline Creek

Environmental Protection Agency, Kansas City, Mo

1972

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WATER QUALITY EVALUATION OF MALINE CREEK

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ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE - REGION VII
1735 BALTIMORE, Kansas City, Mo. 64108
1972

WATER QUALITY EVALUATION OF MALINE CREEK

ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY OFFICE - REGION VII
1735 BALTIMORE, KANSAS CITY, MO. 64108

INTRODUCTION

During the period 1971 - 1972 the U. S. Army Corps of Engineers, St. Louis District is conducting Urban Water Resource Management Studies on five discrete drainage basins in St. Louis County, Missouri. The approach selected by the Corps of Engineers was to conduct a model study on Maline Creek and then use the same methodology on the other basins. The Corps requested assistance from the Environmental Protection Agency on matters pertaining to Water Quality. This report presents the results of the field work completed in response to the Corps request.

SUMMARY

At the request of the Army, Corps of Engineers, St. Louis District, the Environmental Protection Agency, Region VII, Surveillance and Analysis Division, conducted a Baseline Water Quality Investigation of Maline Creek, St. Louis County, Missouri. The objectives of the Survey were:

1. To define existing water quality and aquatic life in Maline Creek.

2. To identify all known sources of pollution entering Maline Creek, and determine the effects of these sources on the water quality.

3. Based on the degree of water quality conditions present, evaluate the feasibility of stream restoration for recreational purposes.

An intensive stream survey was conducted during the period November 16 - 19, 1971, to provide the requisite information. This survey covered the reach of Maline Creek extending from the Continental Can Company outfall approximately one and one-half miles upstream from I-70, to the G.A.F. outfall approximately one-half mile upstream from the Maline Creek-Mississippi River confluence. Water, wastewater, sediment, and biological specimens were collected during the sampling effort.

Analyses revealed sufficient levels of macronutrients to promote algal blooms should impoundment take place anywhere downstream from the Carson Road Bridge. Heavy metals were found in amounts potentially dangerous to aquatic life if allowed to accumulate. High fecal coliform densities cultured from the stream waters after a moderate rain indicated a potential health hazard between the Carson Road Bridge and the Glen-Owen Bridge. The macroinvertebrates identified throughout Maline

Creek were either tolerant, or very tolerant to pollution. The absence of sensitive forms can be attributed to conditions such as insufficient dissolved oxygen, elevated temperatures in isolated portions of the stream, and the detrimental effects of settleable materials released into the stream.

RECOMMENDATIONS

A. Eliminate all effluents discharging into Maline Creek and upgrade present storm sewer systems to prevent overflow during periods of heavy rain.

B. Construct storage impoundments on tributary sources of Maline Creek to insure adequate flow (2 to 5 cfs) during dry periods.

C. Implement stream restoration projects which will improve habitat for warm-water fishes, such as:

1. Increase riffle-pool ratios in mainstream areas.
2. Discourage stream channelization and removal of tree canopies along stream banks.
3. Consult Missouri Conservation Commission, Fisheries Division, for a fish-stocking program once the water quality of Maline Creek is upgraded.

D. Establish surveillance stations in selected reaches of the stream which will monitor the important water quality parameters necessary for the maintenance of aquatic life.

METHODS

A. Chemistry

Water samples for chemical analysis were collected from the following stream stations: 1) MC-0 (Approximately 300 yards Northwest of Riverview Blvd.), 2) MC-1 (Near the Bellefontaine Road Bridge), 3) MC-2 (Near the Chambers Road Bridge), 4) MC-5 (Near the Glen-Owen Road Bridge), 5) MC-6 (Near the Elizabeth Avenue Bridge), 6), MC-7 (Near the Carson Road Bridge). Also, eight outfalls were selected and sampled: 1) MCO-3 (G.A.F. Corporation), 2) MCO-5' (Surface discharge), 3) MCO-6' (Surface discharge), 4) MCO-7 (Certain-teed Prod. and Portland Cement), 5) MCO-8 (Portland Cement), 6) MCO-11 (Unknown source), 7) MCO-37 (Universal Matches storm drain), and 8) MCO-48 (Continental Can Company). Outfalls MCO-3, 37, and 48, along with each stream station were sampled daily. Outfalls MCO-5', 6', 7, and 8 were sampled on the 17th, 18th, and 19th of November. Outfall MCO-11 was sampled only on the 19th due to the lack of discharge on the previous days. Sediment samples were collected from MC-0, 1, 2, 5, 6, and 7 on the first day of the survey. Water and sediment samples were collected, preserved when required, and analyzed in accordance with procedures outlined in Environmental Protection Agency's Methods for Chemical Analysis of Water and Wastes (1971). Each day preserved and unpreserved samples were packed in ice and sent by air freight to the Environmental Protection Agency Regional Laboratory in Kansas City, Missouri, for analysis. The water parameters investigated were:

1. Dissolved Oxygen (D.O.)
2. Biological Oxygen Demand (B.O.D.)

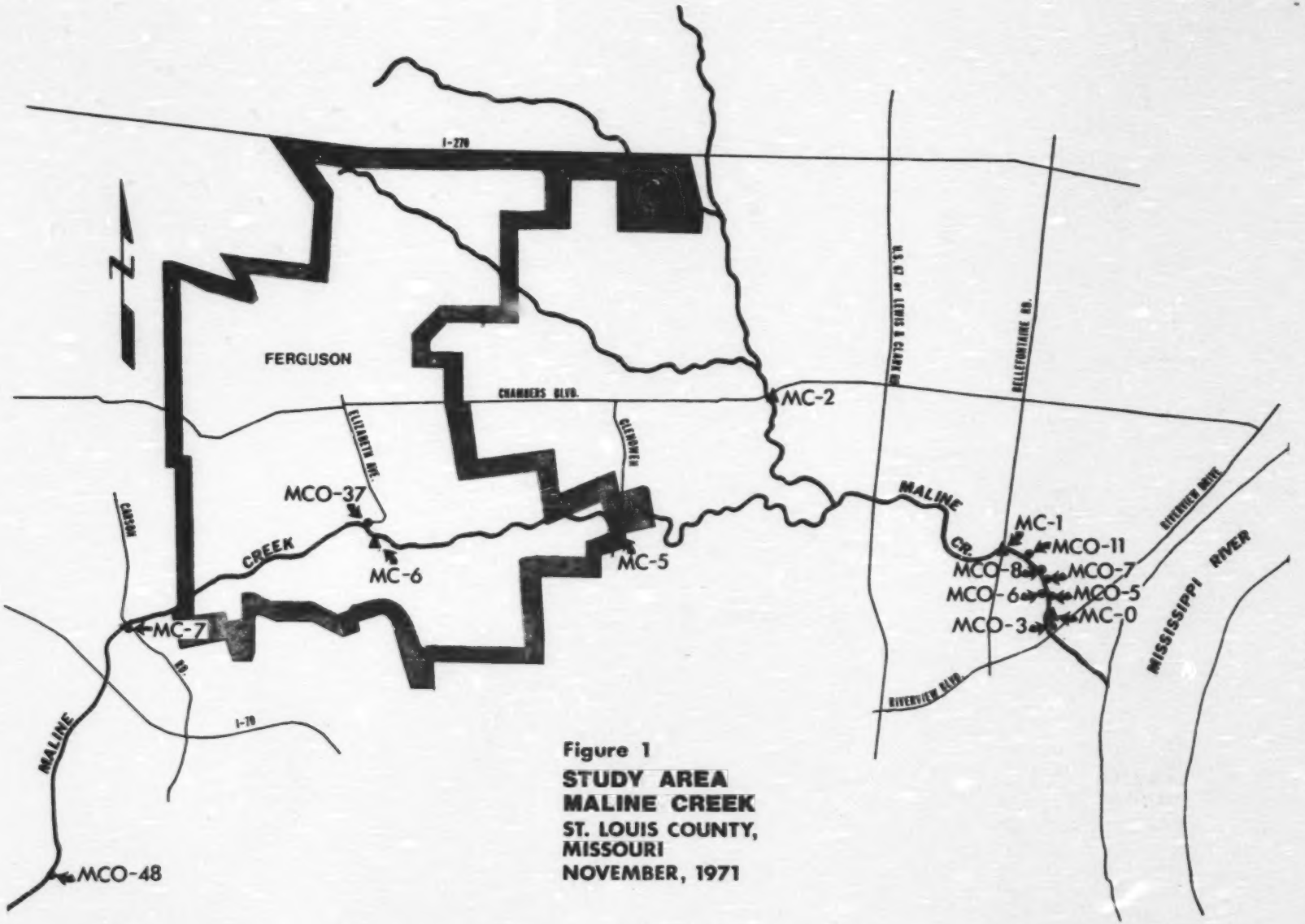


Figure 1
STUDY AREA
MALINE CREEK
ST. LOUIS COUNTY, MISSOURI
NOVEMBER, 1971

3. Ammonia-nitrogen (NH_3-N)
4. Nitrite, and Nitrate-nitrogen (NO_2, NO_3-N)
5. Organic Nitrogen
6. Total Phosphorus
7. Orthophosphate
8. Nonfilterable Solids
9. Selected Heavy Metals
10. pH
11. Alkalinity
12. Conductivity
13. Total Organic Carbon (T.O.C.)

The sediment parameters investigated were:

1. Chemical Oxygen Demand (C.O.D.)
2. Biochemical Oxygen Demand (B.O.D.)
3. Organic Nitrogen
4. Total Organic Carbon

An Army Corps of Engineers chemist analyzed dissolved oxygen concentrations from the stream stations for the first three days of the survey, and Environmental Protection Agency chemists performed the dissolved oxygen analyses for the last day. Table 1 summarizes concentration range and average of each parameter for each station.

B. Bacteriology

Water samples were collected from stream stations MC-0, 1, 2, 5, 6, and 7 each day of the survey. The Army Corps of Engineers provided laboratory facilities in St. Louis for the Environmental Protection Agency microbiologist during the survey. Materials and methods used in sampling, detection, and enumeration of bacterial

TABLE 1

CHEMICAL PARAMETERS OF MALINE CREEK, ST. LOUIS COUNTY, MISSOURI

NOVEMBER 16 – 19, 1971

	MC-0	MC-1	MC-2	MC-3	MC-4	MC-7	MCO-3	MCO-5'	MCO-6'	MCO-7	MCO-8	MCO-11	MCO-37	MCO-48
D.O.*	4.8 3.9 - 6.0	3.8 1.8 - 6.7	6.0 4.4 - 8.3	5.1 4.3 - 6.7	4.8 4.0 - 5.5	4.8 3.1 - 6.2	-	-	-	-	-	-	-	-
B.O.D.*	15.1 9.4 - 26.0	22.8 5.0 - 31.0	29.8 14.0 - 68.0	20.6 9.6 - 48.0	51.3 11.0 -138.0	12.1 2.8 - 36.0	91.0 48.0 - 132.0	13.0 7.0 - 18.0	10.5 8.6 - 13.0	44.3 10.0 - 106.0	149.3 52.0 - 310.0	9.2	209.3 11.0 - 510.0	13.4 1.2 - 25.0
T.O.C.*	26 21 - 35	31 23 - 34	44 25 - 92	30 21 - 48	15 7 - 23	24 13 - 45	60 31 - 80	21 18 - 24	46 41 - 52	39 20 - 72	120 61 - 220	32	144 24 - 420	19 9 - 35
Volatile Solids*	8 2 - 22	12 6 - 21	19 5 - 50	12 5 - 22	91 2 -340	6 3 - 14	35 11 - 60	2 1 - 2	6 5 - 7	39 28 - 54	48 20 - 90	2	46 2 - 110	3 0 - 6
Total Solids*	47 10 - 151	35 11 -100	36 11 -118	41 13 - 84	123 7 -400	24 12 - 42	72 28 - 154	11 1 - 26	52 33 - 72	456 330 - 710	116 68 - 170	6	79 2 - 220	6 0 - 12
pH	11.6 10.4 - 12.0	7.3 6.9 - 7.5	7.3 6.9 - 7.7	7.6 7.5 - 7.6	7.6 7.3 - 7.8	7.7 7.4 - 8.0	8.2 6.9 - 10.0	11.9 11.7 - 12.1	12.0 11.8 - 12.1	12.5 12.3 - 12.8	10.9 10.5 - 11.1	8.0	7.3 6.8 - 7.8	9.5 9.1 - 9.8
Alkalinity*	505 128 - 670	139 80 -165	164 76 -253	118 82 -135	167 81 -200	171 75 -288	101 78 - 151	716 606 - 797	682 638 - 722	1636 1320 - 1900	305 270 - 337	364	91 49 - 127	49 29 - 61
Conductivity**	4110 1040 -5600	670 330 - 860	595 290 -960	645 370 -780	745 320 -940	730 280 -920	691 480 - 930	3833 3400 -4200	4066 3800 -4300	11333 9200 -13000	2333 1400 -3300	970	1247 330 -2100	512 330 -610
Organic Nitrogen*	1.59 1.10- 2.30	1.43 0.90- 1.60	1.64 0.93- 2.70	0.91 0.71- 1.11	0.92 0.53- 1.24	0.69 0.57- 0.99	5.20 2.90- 8.30	1.36 1.25- 1.43	5.93 3.70- 7.20	2.04 1.78- 2.40	14.80 5.40- 28.00	0.00	4.11 0.66- 12.00	0.36 0.13- 0.70
NH_3*	0.32 0.09- 0.49	0.04 0.04- 0.08	0.13 0.00- 0.44	0.03 0.02- 0.05	0.06 0.02- 0.14	0.05 0.02- 0.10	2.24 0.88- 5.60	0.37 0.29- 0.48	0.22 0.16- 0.28	0.90 0.43- 1.46	0.36 0.32- 0.42	2.90	1.76 0.46- 4.80	0.40 0.27- 0.68
NO_2+NO_3*	0.61 0.35- 0.72	0.11 0.03- 0.28	0.27 0.00- 0.76	0.27 0.18- 0.36	0.07 0.00- 0.16	0.07 0.02- 0.18	1.11 0.68- 1.96	0.78 0.67- 0.86	0.92 0.84- 1.04	1.21 1.13- 1.32	2.50 2.47- 2.53	0.81	5.82 2.26- 7.83	0.63 0.59- 0.70
Total Phosphorus*	0.18 0.07- 0.52	0.93 0.52- 1.12	0.50 0.27- 0.87	0.53 0.46- 0.65	0.47 0.30- 0.63	0.36 0.27- 0.64	1.39 1.07- 1.63	0.15 0.07- 0.33	0.05 0.05- 0.05	0.28 0.15- 0.52	2.48 0.82- 3.41	3.22	1.51 0.75- 2.93	0.10 0.06- 0.14
Ortho-phosphate*	0.07 0.01- 0.23	0.64 0.33- 0.79	0.28 0.21- 0.34	0.38 0.33- 0.44	0.32 0.28- 0.43	0.25 0.17- 0.47	-	-	-	-	-	-	-	-
Chromium***	52 00 - 80	-	-	-	-	00	00	85 75 - 90	260 230 - 290	83 40 - 150	00	00	72 00 - 220	00
Iron***	1142 70 -4300	-	-	-	-	2500	755 270 -1600	456 70 -1200	373 300 - 445	1490 170 - 2300	653 300 -1300	280	930 130 -2400	160 60 -260
Zinc***	27 00 - 62	-	-	-	-	76	79 42 - 180	29 00 - 74	40 22 - 70	159 39 - 240	48 31 - 63	32	565 180 -1350	50 15 -110
Copper***	22 15 - 34	-	-	-	-	19	20 6 - 41	19 14 - 26	30 28 - 34	347 17 - 995	26 20 - 38	3	1473 264 -4080	49 11 -117
Manganese***	150 26 - 500	-	-	-	-	880	46 00 - 78	19 00 - 57	311 20 - 880	43 00 - 89	8 00 - 25	1300	83 48 - 140	6 00 - 24
Lead***	300 280 - 340	-	-	-	-	240 170	60 00 - 150	312 130 - 640	306 260 - 340	716 270 - 1200	141 120 - 180	80	162 60 - 280	90 00 -130
Cadmium***	11 00 - 16	-	-	-	-	00	00	18 00 - 39	19 14 - 24	15 12 - 31	00	00	5 00 - 20	00

AVERAGE
Minimum - Maximum

* Milligrams Per Liter
** Micromhos/cm
*** Micrograms Per Liter

densities were in accordance with Standard Methods (1971).

C. Biology

Stations MC-1, 2, 5, and 7 were selected for biological sampling. Both qualitative and quantitative samples were collected from each station. MC-5 and MC-7 were sampled on November 17th, while MC-1 and MC-2 were sampled on the 18th. Qualitative sampling involved a visual inspection of the bottom substrates, such as rocks, and submerged plants, and picking off organisms, e.g., insect larvae, snails, and worms. The material was placed in a suitable preservative for later identification.

Quantitative sampling involved the use of a 9" x 9" Eckman Dredge to retrieve samples in areas of mud substrate. Using a U. S. Standard No. 30 mesh sieve, the mud was rinsed through leaving detritus and benthos organisms. This material was then placed in a jar and preserved in four percent formalin. All biological procedures used were in compliance with Standard Methods (1971).

RESULTS AND DISCUSSION

A. Water Chemistry

1. Dissolved Oxygen

One of the most important constituents in the aquatic environment is dissolved oxygen (D.O.). In appropriate concentrations it not only keeps both aquatic plants and animals alive, but sustains species reproduction, vigor, and the development of populations. The National Technical Advisory Committee (NTAC) (1968) recommends that D.O. concentrations be above 5 mg/l assuming normal seasonal and daily variations for a diversified warm-water biota. The committee also states that under extreme conditions concentrations may range between 5 mg/l and 4 mg/l for short periods during any 24-hour period, provided that the water quality is favorable in all other respects.

The average D.O. concentration at each stream station, with the exception of MC-2, fell below 5 mg/l during the first three days of the survey (Table 1). The D.O. concentrations increased appreciably when analyzed November 19th. This suggests that sufficient oxygen had been introduced through surface agitation, and increased flows by rain of the preceding day.

2. Biochemical Oxygen Demand

Organic materials, present in certain municipal and industrial wastes, remove dissolved oxygen from the aquatic environment during the process of biochemical decomposition and stabilization. A common measure of the strength of these materials is the five-day, 20°C Biochemical Oxygen Demand ($B.O.D._5$).

During the first three days of the survey the B.O.D. concentration reported from MC-7 remained less than 6 mg/l. On the

fourth day, however, the B.O.D. load increased to 36 mg/l (Table 1). This increase in B.O.D. load reflected additional organic material flushed into the stream from stream banks and drain systems by the rain of the preceding afternoon.

Downstream, the highest B.O.D. concentration reported from MC-6 occurred before the influence of the rain. Universal Matches outfall (MCO-37), approximately 30 feet upstream from MC-6, discharged effluent with a B.O.D. concentration over 500 mg/l. Universal Matches was considered to be responsible for the high B.O.D. concentration at this stream station.

Further downstream at MC-5 the average B.O.D. load for the first three days was 12 mg/l. The B.O.D. load increased to 48 mg/l on the fourth day, indicating the addition of organic material from storm runoff.

MC-2, located on a tributary to Maline Creek, had an average B.O.D. concentration of 35 mg/l for the first three days. This B.O.D. load was indicative of possible upstream sources contributing organic materials.

On the main stem of Maline Creek at MC-1, B.O.D. values for the first three days averaged 20 mg/l and on the fourth day the average increased to 23 mg/l during storm runoff.

The B.O.D. load downstream did not exceed an average of 15 mg/l during the four day period in spite of several known B.O.D. load-contributing outfalls located between MC-1 and MC-0 (Table 1). Toxic factors present, such as a high pH, may have inhibited the metabolic activity of micro-organisms crucial to the $B.O.D._5$ test, and, therefore, masked the true B.O.D. load value.

3. Nitrogen and Phosphorus

Two major growth nutrients required by algae are: Nitrogen and Phosphorus. When these nutrients are present in high concentrations as nitrates and orthophosphates, excessive algal growths can be stimulated providing other environmental conditions are satisfied. These excessive growths can become a nuisance: 1) By giving an unsightly green, or blue-green appearance to the water, 2) By producing noxious odors, 3) By removing D.O. from the water when decomposing, resulting in the death of other aquatic organisms, and 4) Certain algal forms produce toxic substances harmful to animals drinking from that source. In streams containing high levels of nutrients, filamentous algal forms can produce streamers as long as fifty feet. These streamers provide an ideal substrate for nuisance animals such as blackfly larvae, midge larvae, and mosquitos. Streaming algae was observed at several stations along Maline Creek.

Phytoplankton, which produce the majority of nuisance algal blooms, require relatively undisturbed waters in which to thrive and prosper. Impounding Maline Creek could not only satisfy the above requirement, but the nutritional requirement as well, judging from the levels of readily available nitrogen and phosphorus already present in the stream. Mackenthun (1965) cites results of a study of 17 Wisconsin lakes indicating that as little as 0.30 mg/l of inorganic nitrogen and 0.01 mg/l of inorganic phosphorus induced algal blooms at the start of an active growing season. Also, an increase in the surface area of the body of water would allow rooted aquatic vegetation, as well as phytoplankton, to develop. If outfalls continued

to discharge levels of nitrogen and phosphorus as noted during the survey (Table 1), the sediments would incorporate the excess nutrients and help to insure future blooms by periodically releasing them when disturbed.

4. Total Organic Carbon (T.O.C.)

Since carbon makes up from fifty to seventy-five percent of the dry weight of algae it must be considered as another major nutrient. Inorganic forms of carbon utilized by algae are usually made available from several sources. One of these is by biological activity on organic carbon present in the aquatic environment. Heterotrophs, e.g. bacteria, metabolize most forms of organic carbon and, in the process, give off CO_2 as a by-product. This, in turn, is used directly by algae.

Organic carbon levels found in the stream samples (Table 3), and in the sediment samples (Table 4) indicate carbon cannot be considered a limiting factor for algal growth in Maline Creek.

5. Nonfilterable Solids

Nonfilterable solids can have adverse affects on aquatic life in several ways: 1) By covering the bottom substrate destroying benthos (invertebrate) organisms, 2) By damaging delicate tissues of aquatic fauna by means of mechanical (ball-mill) action, and 3) By depleting the bottom D.O. supply, if the solids are organic and are actively decomposing. NTAC (1968) states that good or moderate fisheries can be maintained in waters that normally contain 25 to 80 mg/l suspended, chemically inert, solids. This also implies the maximum levels allowable for the maintenance of fish food organisms, e.g. benthos.

The only stations exceeding the 80 mg/l recommended maximum limit during the first three days of the survey were MC-2 with 118 mg/l nonfilterable solids on November 18th, along with MC-6 with 400 mg/l nonfilterable solids also on November 18th. During the 19th, all stream stations downstream from MC-6 exceeded the 80 mg/l recommended limit. This was probably due to overflowing of storm drains into the stream and the flushing of the stream banks by the rain. However, the two industrial outfalls contributed significant amounts of solids when averaged during the four day survey period. MCO-7 and MCO-8 discharged a daily average of 456 mg/l and 116 mg/l, respectively.

6. Heavy Metals

Salts of heavy metals in solution are stable and are not readily removed by oxidation, precipitation, or any other natural process. The problems they pose as pollutants persist for years after their introduction into a body of water. NTAC (1968) purports that any effluent containing foreign materials should be considered harmful and not permissable until proven otherwise by bio-assay tests. The Committee also states that it should be the obligation of the company producing the effluent to demonstrate that it is harmless in the concentrations to be found in the receiving waters. Table 1 presents the average concentrations along with the range of heavy metals analyzed from stream and outfall stations sampled.

7. pH

Most fresh-water organisms can withstand a range in pH from 5.0 to 9.0, but the toxicity of several common pollutants is markedly affected by pH changes within this range, and increasing

acidity or alkalinity can make these pollutants more toxic.

With the exception of MC-0, the stream stations appear to have been within tolerable limits (Table 1). However, Stations MCO-5', 6', 7, 8, and 48 continually dishcarged levels of bases which could be in amounts sufficient to inhibit growth and reproduction of aquatic organisms. NTAC (1968) recommends for fish and other aquatic life that "No highly dissociated materials should be added in quantities sufficient to lower the pH below 6.0 or to raise the pH above 9.0."

8. Alkalinity

Bicarbonates, carbonates and hydroxide ions comprise the alkaline systems of natural waters. The alkalinity of water is a measure of the buffering capacity, or the resistance to pH change with an addition of either acid or base to that water. The NTAC (1968) recommends that "To protect the carbonate system and thus the productivity of the water, acid should not be added sufficient to lower the total alkalinity below 20 mg/l expressed as $CaCO_3$."

Alkalinity values for Maline Creek were 20 mg/l or higher during the study period (Table 1). In fact, MC-0 each day produced levels around thirty times the minimum recommended level except the last day. The high alkalinity values of MC-0 stem from three major outfalls: MCO-5', MCO-6', and MCO-7. The other stream stations ranged from seven to ten times the recommended minimum before the rain on the 18th.

9. Conductivity (Specific Conductance)

This measurement reveals a water's capacity to convey an electric current due to the total concentration of ionic

substances. Most inorganic acids, bases, and salts are good conductors because of their high dissociative nature in water. Standard Methods (1971) states that "Most raw and finished waters in the United States exhibit a specific conductance from about 50 to 500 micromhos/cm, with highly mineralized water in the range of 500 to 1,000 micromhos/cm and even higher." With the exception of MC-0, all the other stream stations were within these limits each day of the survey (Table 1).

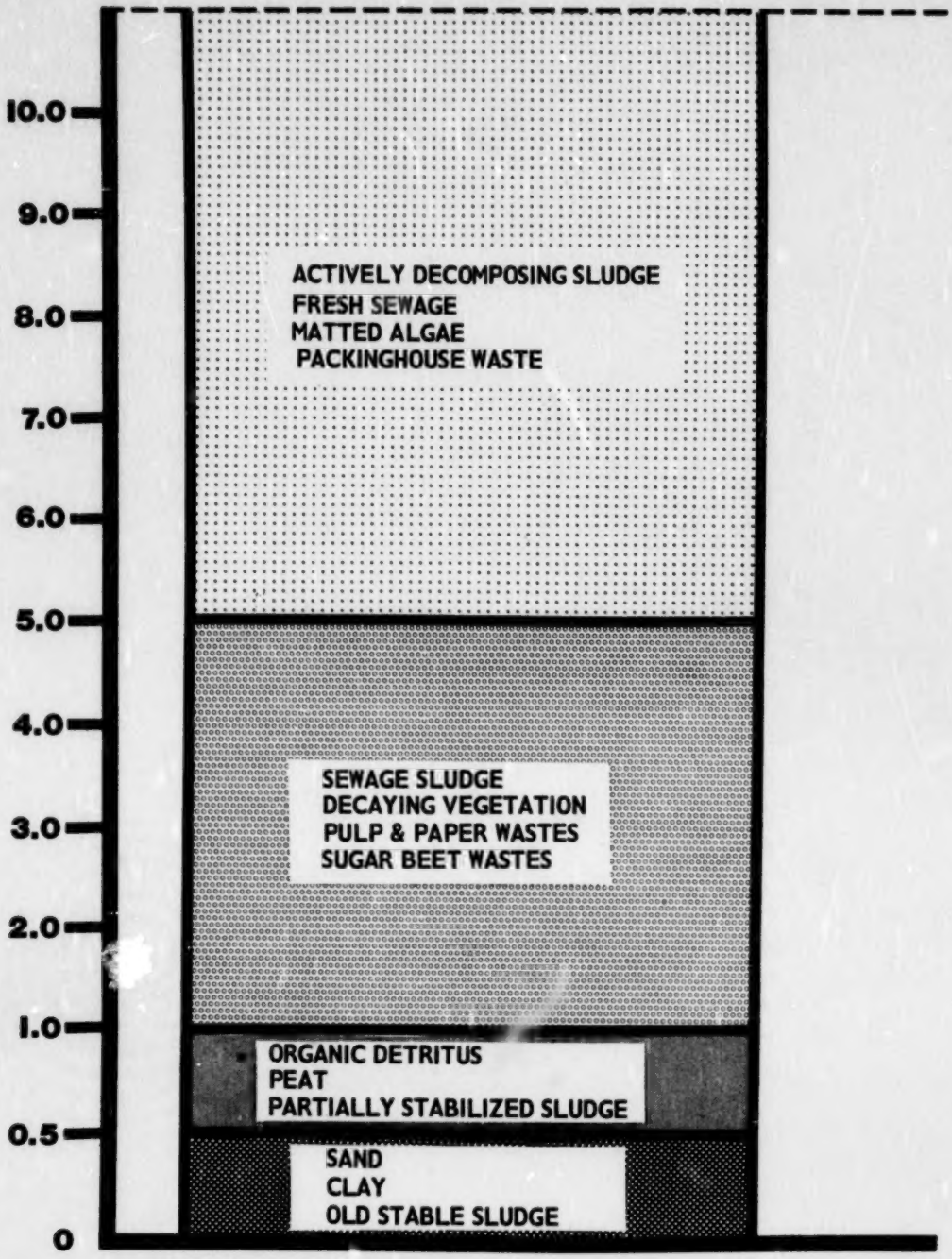
B. Sediments

Particulate material that has been precipitated from overlying waters, or that has been forced along the stream-bed by currents, comprise the bottom sediments. Analysis of bottom sediments provide valuable information by pin-pointing sources of introduced settleable material, and by what effect the sediments have on the quality of overlying water. Ballinger and McKee (1971) developed a means of categorizing sediments. The Organic Sediment Index (Figure 2) is the result of a 2-year examination of bottom sediments from a variety of waters in the U. S. The O.S.I. is the product of the percentage of organic carbon and organic nitrogen in a sediment, and indicates its oxygen demand and nutrient resources.

Organic carbon and nitrogen in sediments utilize D.O. from the overlying waters during decomposition. Problems arise when: 1) Decomposition lowers the D.O. level below the critical level required by aquatic organisms, 2) Sufficient amounts of readily available carbon and nitrogen are released to promote nuisance algal growth, and 3) Undesirable levels of hydrogen sulfide and methane are emitted, fouling the water and the air.

According to the O.S.I., sediments from MC-7, 5, 2, and 1

ORGANIC SEDIMENT INDEX FOR TYPICAL BOTTOM DEPOSITS



I. BALLINGER AND McKEE, 1971

Figure 2

were comparable to sand, clay, or old, stable sludge, or mixtures thereof (Table 2). MC-0 sediment was comparable to organic detritus, peat, or partially stabilized sludge. MC-6 sediment, with the highest O.S.I. value calculated, was interpreted as being actively decomposing sludge. Outfall MCO-37, from Universal Matches, contributed the major portion of the organic material found at MC-6. The effluent from Universal Matches contained significant amounts of organic carbon and nitrogen (Table 2) which settled out in the stream quite rapidly, as indicated by the O.S.I. values for downstream sediements.

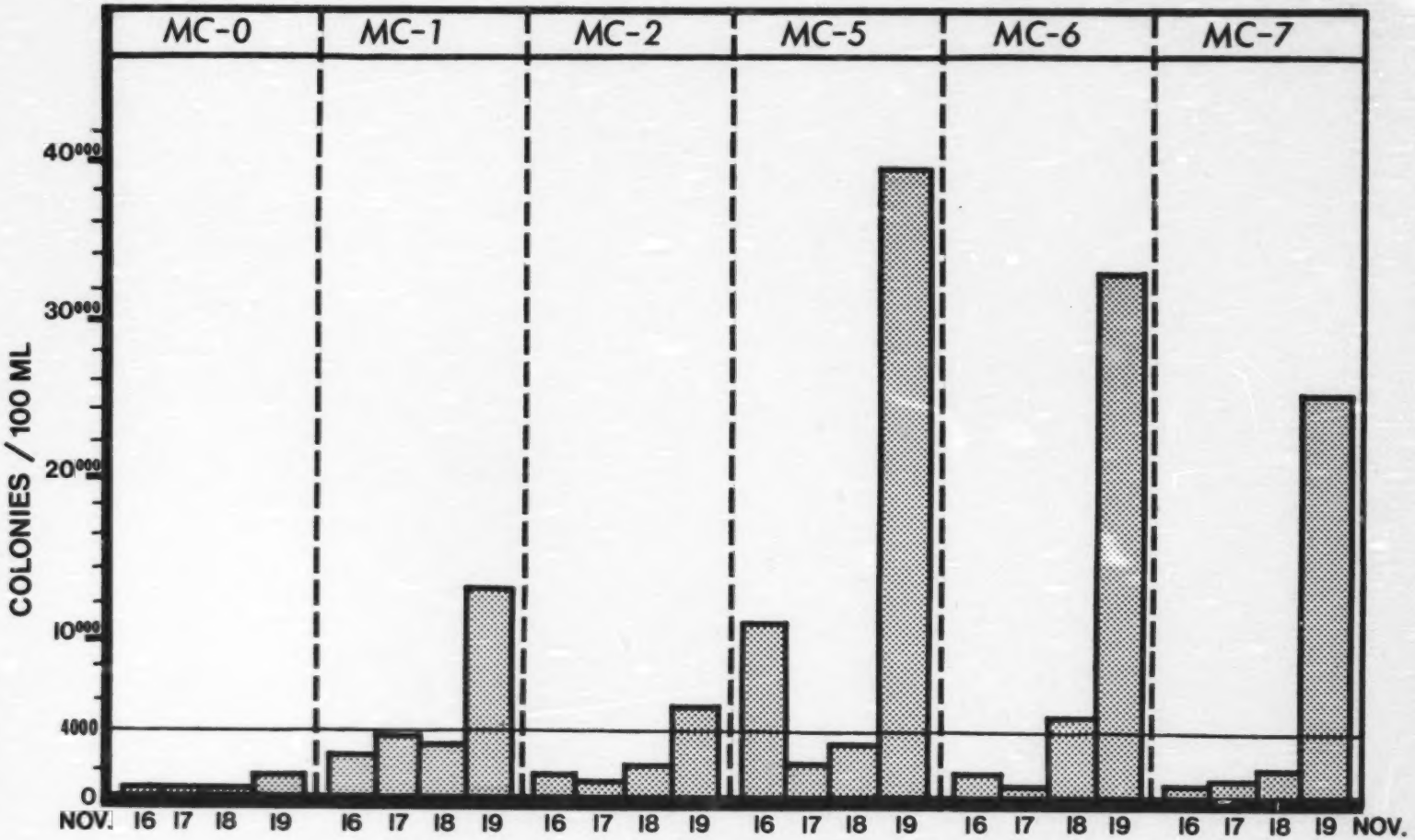
C. Bacteriology

NTAC (1968) recommends that bodies of water, even without official designation of recreational use, should not have fecal coliform counts exceeding an average of 2,000/100 ml, or a maximum of 4,000/100 ml, except in specified mixing zones adjacent to outfalls. With much of Maline Creek passing through residential districts it could be anticipated that children will come in contact with the water. Only two stream stations exceeded 4,000/100 ml before the rain on the afternoon of the 18th (MC-5, 11,000/100 ml on the 16th and MC-6, 4,600/100 ml on the morning of the 18th). Samples taken on the morning of the 19th indicated that every stream station, except MC-0, exceeded the recommended maximum level. The bacterial densities ranged from 5,300/100 ml at MC-2 to 40,000/100 ml at MC-5 (Table 3). Figure 3 illustrates the accumulating effect coming downstream from MC-7 to MC-5. The major source of bacterial densities appeared to be from storm run-offs. MC-2, a station on a tributary of Maline Creek, appeared to have had a diluting rather than a contributing affect on the main stream, for the count at MC-1 was much lower than the

TABLE 2

MALINE CREEK SEDIMENT VALUES FOR SELECTED PARAMETERS
INCLUDING THE ORGANIC SEDIMENT INDEX CALCULATIONS
SAINT LOUIS COUNTY, MISSOURI
NOVEMBER 16, 1971

STREAM STATION	C.O.D. mg/kg	ORGANIC CARBON %	ORGANIC NITROGEN mg/kg	ORGANIC NITROGEN %	ORGANIC SEDIMENT INDEX O.S.I.	B.O.D. mg/kg
MC-0	32000	8.22	900	0.09	0.74	3200
MC-1	26000	6.68	500	0.05	0.33	3500
MC-2	28000	7.20	100	0.01	0.07	1800
MC-5	20000	5.14	600	0.06	0.31	2200
MC-6	110000	28.30	1800	0.18	5.09	13000
MC-7	14000	3.60	400	0.04	0.14	1500



FECAL COLIFORM DENSITIES
MALINE CREEK
ST. LOUIS COUNTY, MISSOURI
NOVEMBER 16-19, 1971

Figure 3

TABLE 3

A SUMMARY OF BACTERIAL DENSITIES RECOVERED FROM MALINE CREEK, SAINT LOUIS COUNTY, MISSOURI NOVEMBER 16 - 19, 1971

MC-0	11/16/71	11/17/71	11/18/71	11/19/71	Arithmetic Average (Nearest 100)
Total Coliform	< 5	< 2	< 2	2100	500
Fecal Coliform	< 5	< 2	< 2	540	100
Fecal Streptococci	5	< 2	2	34000	8500
MC-1					
Total Coliform	3300	5300	2200	560000	142700
Fecal Coliform	2400	3800	3300	13000	5600
Fecal Streptococci	930	870	11000	59000	18000
MC-2					
Total Coliform	3100	1100	420000	200000	156100
Fecal Coliform	790	330	1400	5300	2000
Fecal Streptococci	1100	530	25000	42000	17200
MC-5					
Total Coliform	13000	25000	31000	660000	182300
Fecal Coliform	11000	1700	3300	40000	14000
Fecal Streptococci	1000	1100	3100	76000	20300
MC-6					
Total Coliform	2100	700	15000	50000	17000
Fecal Coliform	1200	40	4600	33000	9700
Fecal Streptococci	870	420	2300	79000	20600
MC-7					
Total Coliform	1100	4000	3200	450000	114600
Fecal Coliform	170	430	840	26000	6900
Fecal Streptococci	200	520	620	55000	14100

VALUES EXPRESSED AS COLONIES PER 100 ML.

preceding main stream stations. Stations MC-7, 6, and 5 are primarily in residential areas where humans are most likely to come in contact with the stream. Bacterial densities at MC-0 were very low when analyzed the first three days of the survey. This was probably due to the high pH and alkalinity levels, and possibly the toxic affects of the heavy metals present at that station.

D. Biology

Macroinvertebrates are used as water quality indicators for several reasons: 1) These organisms are relatively stationary and therefore cannot avoid pollutants, 2) Since the life cycle of many organisms extended beyond one year, their presence, or absence, indicates water quality of the past as well as the present, 3) They are easy to collect and require less time to prepare and interpret than are other segments of the aquatic community.

Competition for food and living space are major factors that keep the numbers of individuals of a species in check. Deterioration of water quality caused by the build-up of organic pollutants allow certain organisms to prosper, while others are eliminated. The macroinvertebrates can be classified into three pollution tolerant groups: 1) The clean water (sensitive) group, 2) The facultative, or tolerant group, and 3) The very tolerant group. Clean, natural waters are characterized by having a large diversity of macroinvertebrates, but relatively few individuals of each kind. (A macroinvertebrate is defined as an invertebrate that is retained by a U. S. Standard No. 30 mesh sieve.)

None of the twenty-nine kinds of macroinvertebrates found in Maline Creek were pollution-sensitive. Twenty-three kinds were tolerant

and six kinds were very tolerant to organic pollutants (Table 4). The absence of pollution-sensitive organisms stems from various causes. Some of these are: 1) Insufficient D.O., 2) Increased temperatures in isolated areas of the stream during low flow periods, 3) Deposition of inert and organic materials from outfalls covering favorable substrates, and 4) The possible toxicity of heavy metals discharged from outfalls.

TABLE 4

MACROINVERTEBRATES FOUND IN MALINE CREEK, ST. LOUIS COUNTY, MISSOURI DURING NOVEMBER 17 – 18, 1971

	MC-1	MC-2	MC-5	MC-7
A. TOLERANT MACROINVERTEBRATES/SQ. FT.				
HYDROZOA				
Hydra	--	--	--	1
OLIGOCHAETA				
Aeolosoma	--	Q	--	--
Branchiobdellidae	--	--	Q	--
HIRUDINEA				
Glossiphoniidae	Q	--	--	--
Piscicolidae	Q	--	--	--
GASTROPODA				
Lymnaea	Q	--	--	Q
Ferrissia	Q	--	--	--
Gyraulus	1	--	--	1
PELECYPODA				
Musculium	16	97	--	--
CRUSTACEA				
Orconectes	--	--	Q	--
Asellus	Q	Q	Q	--
ODONATA				
Argia	--	--	Q	--
DIPTERA				
Tipulidae	Q	Q	--	--
Bessia	--	Q	--	--
Ablabesmyia	--	--	--	Q
Anatopynia	--	--	1	3
Cricotopus	24	--	7	--
Cryptochironomus	Q	--	--	--
Endochironomus	--	--	--	1
Pentaneura	--	1	--	--
Procladius	14	26	16	3
Tanypus	--	--	1	--
Zavrelimyia	--	--	Q	--
B. VERY TOLERANT MACROINVERTEBRATES/SQ. FT.				
OLIGOCHAETA				
Naididae	--	3	--	Q
Tubificidae	1091	696	816	2309
PULMONATA				
Physa	3	10	Q	7
DIPTERA				
Chironomus	14	--	3	--
Psychoda	--	Q	--	--
Glyptotendipes	--	--	Q	--
Q = Found in Qualitative Sampling Only.				
Total No. of Organisms/Sq. Ft.	1163	833	844	2325
Total No. of Kinds	14	11	13	10
Total No. of Tolerant Kinds	11	7	9	7
Total No. of Very Tolerant Kinds	3	4	4	3

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